ARJUNA

JEE

LECTURE - 15

Mole Concept

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Q. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene?

40sec - 60sec

A 2.8 kg

B 6.4 kg

C 9.6 kg

D 96 kg

$C \rightarrow CO_2$

$H \rightarrow H_2O$

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

$(\text{mole})_{C_2H_4} = \frac{2.8 \times 10^3 \text{ gram}}{28} = 0.1 \times 10^3 \text{ mole}$

Stoichiometry → Rule - ① Rxn Balance

② given information Convert into mole

③ $\left(\frac{\text{Mole}}{\text{Coeff.}}\right)$ Ratio barabar krna hai | Jo diya jaye aur jo Quest^n puchha jaye |

$\frac{(\text{Mole})_{C_2H_4}}{1} = \frac{(\text{mole})_{O_2}}{3}$

$\frac{0.1 \times 10^3}{1} = \frac{(\text{mole})_{O_2}}{3}$

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mole of O_2 = $0.1 \times 10^3 \times 3$

$= 3 \times 10^2$ mole

mass of O_2 = $3 \times 10^2 \times 32$ gram

$= 96 \times 10^2$ gram

$= \frac{96 \times 10^2}{10^3}$ kg

$= \underline{\underline{9.6}}$ kg

Q. Liquid benzene (C_6H_6) burns in oxygen according to the equation, $2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(g)$. How many litres of O_2 at STP are needed to complete the combustion of 39g of liquid benzene? (Mol. Weight of O_2 = 32, C_6H_6 = 78)

1-2 minutes

A 74 L

B 11.2 L

C 22.4 L

D 84 L

$2C_6H_6 + 15O_2 \longrightarrow 12CO_2 + 6H_2O$

$\frac{(\text{Mole})_{C_6H_6}}{2} = \frac{(\text{Mole})_{O_2}}{15}$

R-1 → Balance hai

R-2 → $\frac{39 \text{ gm } C_6H_6}{78}$

$= \frac{1}{2}$ mole $= 0.5$ mole C_6H_6

Mole of $O_2 = \frac{15}{2} \times 0.5 = \frac{7.5}{2}$ mole

Vol. of O_2 at S.T.P $= \frac{7.5}{2} \times 22.4$

$= 84$ Litre

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Case- if value of more than one reactant given (LIMITING REAGENT)

Q. 2 mole A and 3 mole B react with each other

$A + B \rightarrow AB$

2	3	0	t=0
↓			
2-2	3-2		
(0)	(1)		

L.R. = A

E.R. = B

Limiting Reagent (L.R.)

Jo Reactant, chemical Reaction me pahele khatam ho jata hai

Excess Reagent

Jo Reactant, chemical rxn me bach jata hai (other Reactant except L.R.)

$C_{SD} = 46$

① 1 se jada Reactant Ki value given hai, matlab limiting Reagent Ka Case ho sakta hai

Rule ① Reaction → Balance honi chahiye

② given information ko mole me convert Kote hai

③ $\left(\frac{\text{mole}}{\text{ceo.}}\right)$ Ratio nikalna hai Reactant Ka

④ Jis Ka $\left(\frac{\text{mole}}{\text{ceo.}}\right)$ raho Chota hoga (small hoga), wahi L.R. hoga

⑤ Reactant & product in value, always L.R. Ke respect me nikalna hai

$$\left[\left(\frac{\text{mole}}{\text{Ceo}}\right)_{\text{Ratio}}\right]_{\text{L.R.}} = \left(\frac{\text{mole}}{\text{Ceo}}\right)_{\text{jiski value nikalni ho.}}$$

Q 4mole of A react with 8 mole B and form A_2B_3 molecule

$$2A + 3B \longrightarrow A_2B_3$$

Calculate

(a) L.R. → ?

(b) E.R → ?

(c) How many mole of A_2B_3 form

$$2A + 3B \longrightarrow A_2B_3$$

4mole 8mole

Check L.R. $\frac{4}{2}$ $\frac{8}{3}$

1=2 = 2.67

L.R.

(a) L.R. = A

(b) E.R. = B

$$\frac{(\text{mole})_A}{2} = \frac{(\text{mole})_{A_2B_3}}{1}$$

$\frac{4}{2}$ = mole of A_2B_3

2 = mole of A_2B_2

Q $A_2 + 3B \longrightarrow A_2B_3$

1 mole of A react with 2 mole of B.

Select correct statements

(a) B is a L.R. Sahi hai

(b) A_2 is a L.R.

(c) $\frac{2}{3}$ mole A_2B_3 form

(d) 'a' & 'c' both correct

Sol^n $A_2 + 3B \rightarrow A_2B_3$ (B: L.R.)

1 mole 2 mole

Check L.R. $\left\{ \frac{1}{1} \quad \frac{2}{3} \rightarrow \text{L.R.} \right.$ $\frac{2}{3}$ → smaller value hai

$$\frac{(\text{mole})_B}{3} = \frac{(\text{mole})_{A_2B_3}}{1}$$

$$\frac{2}{3} = (\text{mole})_{A_2B_3}$$

Q. 10g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be:

A 2 moles

B 3 moles

C 4 moles

D 1 mole

$2H_2 + O_2 \longrightarrow 2H_2O$ (L.R. at O_2)

10g 64g

$\frac{10}{2} = 5$ mole $\frac{64}{32} = 2$ mole

Check L.R. $\frac{5}{2} = 2.5$ $\frac{2}{1} = 2$

$\frac{(\text{mole})_{O_2}}{1} = \frac{(\text{mole})_{H_2O}}{2}$

mole of $H_2O = 2 \times (\text{mole})_{O_2}$

$= 2 \times 2$

$= 4$ mole

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Q. When 22.4 L of $H_2(g)$ is mixed with 11.2 L of $Cl_2(g)$, each at STP, the moles of HCl(g) formed is equal to

A. 1 mole of HCl(g)

B. 2 moles of HCl(g)

C. 0.5k mole of HCl(g)

D. 1.5 moles of HCl(g)

L.R.

$H_2 + Cl_2 \longrightarrow 2HCl$

22.4 L 11.2 L

$\frac{22.4}{22.4} = 1$ mole $\frac{11.2}{22.4} = 0.5$ mole

Check L.R. $\frac{1}{1} = 1$, $\frac{0.5}{1} = 0.5$

$\frac{(\text{mole})_{Cl_2}}{1} = \frac{(\text{mole})_{HCl}}{2}$

Mole of HCl $= 2 \times (\text{mole})_{Cl_2}$

$= 2 \times 0.5$

$= 1$ mole

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Q. 1.0 g of magnesium is burnt with 0.56 g of oxygen in a closed vessel. Which reactant if left in excess and how much? (At weight of Mg = 24, O = 16)

[

[A] Mg, 0.16g

[B] O_2, 0.16g

[C] Mg, 0.44g

[D] O_2, 0.28g

$2Mg + O_2 \rightarrow 2MgO$ (L.R)

1 gram 0.56 gram

$\frac{1}{24}$ mole $\frac{0.56}{32}$ mole

Check L.R.: $\frac{\frac{1}{24}}{2} = \frac{1}{48} = 0.02$; $\frac{\frac{0.56}{32}}{1} = \frac{0.56}{32} = 0.0175$

$\frac{(\text{mole})_{O_2}}{1} = \frac{(\text{mole})_{Mg}}{2}$

$\frac{\left(\frac{0.56}{32}\right)}{1} = \frac{(\text{mole})_{Mg}}{2}$

Mole of Mg $= 2 \times \frac{0.56}{32} = 0.035$ Mole

Excess mole of Mg $= \frac{1}{24} - 0.035$

$= 0.0066$ mole

$= 0.16$ gram

Q. In the reaction

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(I)$

When 1 mole of ammonia and 1 mole of O_2 are made to react to completion, then

2 minutes

A ✗ 1.0 mole of H_2O is produced

B ✗ 1.0 mole of NO will be produced

C ✓ all the oxygen will be consumed

D ✗ all the ammonia will be consumed

$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$ (L.R.)

1 mole 1 mole

Check L.R.: $\frac{1}{4}$ $\frac{1}{5}$ = Small

$\frac{(\text{mole})_{O_2}}{5} = \frac{(\text{mole})_{NO}}{4}$,

$\frac{1}{5} = \frac{(\text{mole})_{NO}}{4}$, $(\text{mole})_{NO} = \frac{4}{5}$ mole

$\frac{(\text{mole})_{O_2}}{5} = \frac{(\text{mole})_{H_2O}}{6}$, $(\text{mole})_{H_2O} = \frac{6}{5}$ mole

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Home work

DPP 11

Thank - You